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Orbits of the Spectroscopic Components of Boss 2484

BY

W. E. HARPER, M.A.

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ORBITS OF THE SPECTROSCOPIC COMPONENTS OF BOSS 2484

BY W. E. HARPER, M.A.

This star ($\alpha = 9^h\ 10^m{\cdot}8$, $\delta = +47^\circ\ 14'$) was announced by Adams as a spectroscopic binary in the *Publications of the Astronomical Society of the Pacific* in December, 1914. Professor Adams kindly communicated the velocities of their five plates shortly after I undertook the investigation of its orbit. In reply to my query as to the presence of the spectrum of the second component, which in the meantime had been recorded here, he stated that both components of the magnesium line λ 4481 had been measured on one plate, though with considerable uncertainty in the case of the fainter component. The measures appear later on.

The star is of photographic magnitude 5·8 and of type A2. While some of the early plates show numerous lines, probably because in many of these the component spectra were superposed, thereby increasing the contrast, yet in nearly all the later plates, upon which the orbit mainly depends, the hydrogen lines with the magnesium λ 4481 and calcium λ 3933 are all that are available for measurement. The orbit proves to be quite eccentric ($e = \cdot 5$) and for about 13 days of its 16-day period the spectra are too close to be resolved with our present equipment. Fortunately, the general form of the curve was obtained from the first few revolutions, so that only a limited number of observations have not been made use of. While the influence of the secondary spectrum upon the measures of the main one seems to be much less than might be expected, yet it was felt that the only plates that could be depended upon were those wherein the components were completely separated or centrally superposed. The practice was thus adopted of observing the star only at the times when the lines were completely resolved. Adams' observations taken in conjunction with our own gave a period of 15·986 days, a value so close to the even day that observations at any one season on the three particular nights would give only three points on the curve. Consequently, it was very disappointing that the desired nights in the autumn of 1915, when different

phases could have been observed, were for the most part cloudy. The star is still available at time of writing, but it is felt that observations now would not add any special weight to the determination.

As the spectral lines have been resolved over such a limited portion of the orbit, it is hoped that when the large reflector at Victoria is ready for use, additional observations, using greater dispersion, will be secured and the orbit determined with greater precision. For this reason the present determination is considered only a preliminary one. On 28, out of the total of 49 plates secured, the spectra are separated, and these 28 measures of the primary, together with 2 plates where the spectra must be nearly superposed, are used in the determination. The spectrum of the secondary component is so poorly defined that only 13 measures of it have been accepted as at all trustworthy. In some cases only a single line is used. These 13 measures, duly weighted, have been combined with the 30 just mentioned in the solution. All the plates have been made on Seed 27 emulsion with spectrograph I^1 whose dispersion is 32·3 Å per millimetre at the minimum deviation, λ 4325.

The following table gives the wave-lengths which were used for the lines measured. They were adopted from a star of similar type, 14 Aurigæ, and have not been revised for this star. The number of times measured on 28 plates with the residuals for each line from the mean of the plate is also shown. After this table the detailed measures of the plates are given.

TABLE OF WAVE-LENGTHS

λ	n	Mean Numerical Residual	Mean Algebraic Residual	λ	n	Mean Numerical Residual	Mean Algebraic Residual
4572·190	1	.....	+10·3	4236·000	5	6·9	+ 5·3
4549·743	8	10·4	− 1·9	4233·425	11	13·6	+ 4·4
4481·477	26	7·7	− 0·3	4202·366	1	.....	− 5·1
4415·345	1	.....	+ 3·3	4143·839	3	15·7	+ 6·5
4404·861	2	15·8	− 9·2	4101·898	6	6·7	− 5·9
4340·645	14	9·2	− 0·1	4077·862	1	.....	+ 2·3
4325·698	3	9·5	0·0	4071·865	7	4·8	− 1·4
4307·974	5	15·3	+ 9·3	4063·730	3	2·9	+ 2·9
4271·675	6	8·7	− 2·6	4045·940	8	10·7	+ 4·1
4260·537	1	.....	−19·0	3933·825	14	6·9	− 3·8

MEASURES OF BOSS 2484 (primary)

λ	6790		6800		6809		6816		6823		6830		6838	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4549	+23·2	½	.....	.....	.....	.....	.....	.....	+72·0	¼	+24·8	½	.....	.....
4481	+ 6·6	½	−15·0	¾	− 5·2	¼	−34·2	¼	92·7	1	7·9	½	+23·1	¼
4340	+13·4	¾	+ 1·5	½	−23·5	½	.....	.....	86·2	1	12·8	½	30·8	½
4325	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38·6	¼	.....	.....
4271	+ 6·8	1¼	.....	.....	.....	.....	−28·6	½	94·8	¼	.....	.....	.....	.....
4233	.....	.....	− 7·3	½	.....	.....	.....	.....	.....	.....	.....	.....	1·8	½
4143	+23·8	½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4101	−22·0	½	.....	.....	+17·2	¼	.....	.....	109·7	¼	.....	.....	2·8	½
4077	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31·4	¼	.....	.....
4071	+ 4·7	½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4063	−27·1	½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1·1	¾
4045	− 2·9	½	−10·7	½	.....	.....	.....	.....	94·0	¼	.....	.....	.....	.....
4005	+ 8·7	½	.....	.....	+ 1·5	½	.....	.....	.....	.....	.....	.....	10·4	¼
3933	.....	.....	−10·3	½	− 7·6	¼	−17·8	¼	+104·7	1	+23·4	½	+ 6·4	¾
Weighted mean	+ 4·40		− 8·90		− 5·66		−27·33		+94·05		+20·80		+ 9·10	
V_s	− 9·95		−10·39		−10·83		−11·71		−14·76		−15·46		−15·81	
V_d	− ·03		− ·05		− ·04		− ·05		− ·15		− ·10		− ·08	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 5·9		− 19·4		− 16·8		− 39·3		+ 78·9		+ 5·0		− 7·1	

MEASURES OF BOSS 2484 (primary)—*Continued*

λ	6846		6852		6861		6865		6870		6876		6881	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4549	−28·1	¾			−10·1	¾	+13·3	½	0·0	1			− 8·5	¼
4481	−20·6	¼	−21·0	¾	−10·2	¾	−16·4	½	+ 8·2	1	+71·4	½	+ 9·7	½
4401									9·1	¾			+23·7	½
4351													−12 8	
4340	− 0·1	¾	21·8	¾	−32·0	½	+12·6		8·3	¾	97·3	½	+ 2 1	½
4325									20·1	½				
4307									24·5	1	69·3	½		
4294									1·9	1				
4271	+ 7·6	½							11·7	1			+ 5·8	¼
4233	−11·4	¼	30·6	¾			− 5·4	¾	5·9	1			+11·8	¾
4227					− 5·3	½			14·4	¾				
4202									6·1	1				
4198							+ 4·5	½						
4101					+14·9	½	+ 4·3	½			89·1	¾		
4077			20·9	½	− 2·3	½								
4071			18·4	½					12·0	½	87·4	½		
4063							+ 3·2	¼						
4045	− 6·8	½	31·2	½					+25·4	1	78·3	¼		
3933	−15·1	½	−22·2	½	− 5·6	1	− 2·9	¼			+92·0	1½	+28·9	¾
Weighted mean	− 9·10		−24·00		− 7·50		+ 1·40		+11·30		+86·04		+10·30	
V_ε	−16·83		−17·51		−18·81		−19·10		−19·39		−20·25		−20·54	
V_δ	− ·09		− ·02		− ·13		− ·06		− ·06		− ·04		− ·06	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−26·3		−41·8		−26·7		−18·0		− 8·4		+65·5		−10·6	

MEASURES OF BOSS 2484 (primary) *continued*

λ	6897		6900		6902		6915		6921		6932		6934	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4572	+ 9·4	¼											+80·1	½
4549	0·0	½					+ 8·8	¼	+ 2·4	¼			94·4	½
4481	+ 9·3	¼	+107·3	½	+23·9	¾	−21·2	¼	− 12·5	½	+46·1	½	62·9	¼
4415													87·1	¼
4340			127·2	¼	10·9	1	+ 5·9	¾	− 7·5	½			94·6	¼
4325	−14·2	¼												
4307	+23·3	¾							− 1·3	¼				
4271									+28·1	½				
4236							− 4·3	¼						
4233			115·0	¼			+19·4	½					103·6	¼
4143									+ 2·2	¼				
4101			97·5	¼										
4071													88·8	½
4063	+ 5·1	½												
4045			89·7	¾			−36·1	½	+ 6·4	½			+119·6	¼
3933	−29·4	¼	+99·2	¾	+29·7	½					+56·9	¾		
Weighted mean	+ 5·00		+100·91		+28·67		− 3·67		+ 2·93		+52·57		+90·36	
V_0	−23·09		− 23·81		−23·98		−25·00		−25·13		−25·46		−25·62	
V_d	− ·02		+ ·03		− ·04		− ·15		− ·12		− ·16		− ·15	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−18·4		+ 76·8		+ 4·4		−29·1		−22·6		+26·7		+64·3	

MEASURES OF BOSS 2484 (primary)—*Continued*

λ	6965		6986		7325		7333		7337		7338		7367	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4572					−25·5	¼								
4549	+63·8	½			45·8	½					+19·3	¼		
4534					38·3	¼								
4481	66·7	½	−20·5	¾	69·7	¼	+15·1	¾	+48·7	½	8·5	½	+25·6	1
4404			−14·1	¼										
4351	+63·4	¼												
4340					27·7	½								
4325											31·0	¼		
4307					21·6	¼	44·4	¼						
4271			+20·0	¼	17·3	¼								
4260							+46·1	¼						
4233					27·7	¼			24·9	¼	+22·1	¼		
4143					45·6	¼								
4063			−17·8		36·7	¼								
4045					34·4	½			+66·0	½				
3933					−30·5	¾								
Weighted mean	+64·88		−13·03		−34·28		+27·12		+50·86		+17·85		+25·56	
Va	−25·41		−24·63		+24·90		+24·76		+24·62		+24·48		+26·07	
Vd	− ·23		− ·17		+ ·13		+ ·18		+ ·13		+ ·19		+ ·09	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+39·0		−38·1		− 9·0		+51·8		+75·3		+42·8		+51·4	

MEASURES OF BOSS 2484 (primary)—*Continued*

λ	7403		7404		7408		7461		7468		7469		7486	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4549	+53·1	¼					−22·8	¾	+80·4	½	+80·0	¼		
4481	55·9	½	+64·0	½	+10·4	¾	23·9	½	65·3	½	+92·2	½	+38·6	½
4351							16·0	¾						
4340	52·7	½							55·2	½				
4325	70·0	¼	57·4	¼										
4307							21·7	½						
4271			73·1	¼										
4236													28·0	½
4233			52·8	½	+ 1·3	½	22·2	¼	48·6	½			21·8	¼
4198							21·3	¼						
4143			40·2	½			1·9	½						
4063									59·1	¼				
4045	32·4	½	+49·5	¼					+36·1	¼				
3933	+58·0	½					−26·5	½					+40·5	¼
Weighted mean	+52·22		+54·90		+ 8·12		−19·24		+59·42		+88·13		+25·87	
V_a	+25·28		+25·28		+25·16		+12·73		+11·89		+11·89		+ 5·46	
V_d	+ ·13		+ ·05		+ ·14		+ ·03		+ ·07		− ·03		+ ·13	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+77·4		+80·0		+33·1		− 6·8		+71·1		+99·7		+31·2	

MEASURES OF BOSS 2484 (primary)—*Continued*

λ	7487		7500		7534		7535		7537		7538		7544	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt	Vel.	Wt.	Vel.	Wt
4549									+47·3	½				
4481	+41·1	½	+82·7	¼	+14·7	½	+40·0	¾	56·9	¾	+103·1	¾	− 9·0	½
4340			+51·6	¾					61·0	¼				
4307			+33·1	¼					55·1	¼				
4202					31·4	¾								
4071					30·3	½								
4045	+31·4	¼					+31·9	½						
3933					+26·4	½			54·7	½				
Weighted mean	+37·87		+54·12		+26·27		+36·80		+54·40		+103·10		− 9·00	
Va	+ 5·46		− 2·76		−15·29		−15·29		−15·29		− 15·66		−18·42	
Vd	+ ·09		+ ·10		+ ·18		+ ·11		− ·03		+ ·13		− ·11	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+43·1		+51·2		+10·9		+21·4		+38·8		+87·3		−27·8	

MEASURES OF BOSS 2484 (primary)—*Continued*

λ	7557		7559		7560		7599		7600		7602		7603	
	Vel	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel	Wt.	Vel.	Wt.
4481	+ 98·6	½	+115·7	¾	+106·0	¾	+ 47·4	¼			+ 78·0	½		
4404			100·4	½										
4340	125·6	½	88·4	½	87·2	½	59·8	¾			71·6	½	+ 64·2	¼
4325							34·9	½	+ 67·0	¼	70·4	½		
4307									50·7	¾				
4271							54·0	¾					64·8	¼
4236	107·9	½			70·4	¼								
4233													62·9	¼
4143											81·0	½		
4101					113·4	¼							80·5	½
4077			104·4	¼										
4071			130·5	¼			51·9	¼			63·6	½	73·2	¼
4063									69·4	¼			64·0	¼
4045	115·5	¾			91·4	½	47·5	¼	+82·2	¼			89·7	¼
3933	+ 95·2	½	+ 107·2	½	+117·0	½	+ 74·8	¼			+ 67·2	½	+ 79·5	¼
Weighted mean	+108·84		+ 106·73		+99·35		+ 49·64		+70·20		+71·82		+73·60	
V_0	−20·70		−20·70		−20·70		−23·94		23·94		−24·26		−24·26	
V_2	+ ·05		·11		− ·18		− ·03		·12		·09		− ·15	
Curv	− ·28		− ·28		− ·28		− ·28		− ·28		·28		− ·28	
Radial Velocity	+87·9		+85·6		+78·2		+25·4		+45·9		+47·2		+48·1	

MEASURES OF BOSS 2484 (secondary)—*Continued*

λ	6823		7408		7468		7469		7486		7487		7535	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4549	− 91·7	½	....		−118·1	½	−155·7	½						
4481	128·7	½	−104·0	½			144·7	½					−66·0	½
4340	....		....		126·2	½								
4307									−81·6	½				
4271	99·0	½												
4250	.....		.....		−138·6	½								
4101	114·7	½												
4045											85·3	½		
3933	−125·1	½												
Weighted mean	−116·32		−104·00		−127·92		140·20		−81·60		−85·30		−66·00	
Va	− 14·76		+ 25·16		+ 11·89		+ 14·89		+ 5·46		+ 5·46		−15·29	
Vd	− ·15		+ ·14		+ ·07		− ·03		+ ·13		+ ·09		+ ·11	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−131·		− 79·		−116		129·		− 76·		− 80·		− 81·	

MEASURES OF BOSS 2484 (secondary)—*Concluded*

λ	7538		7557		7559		7560		7602		7603			
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481	−104·8	¾	77·8	¼	−104·8	½	−78·3	½						
4404					77·9	½								
4271					111·0	½								
4233			65·5	¼	149·0	¼								
4143			112·8	½										
4101							108·7	¼						
4045			105·6	¼					−64·3	¼	−50·9	¼		
3933			−119·2	¼	−89·4	¼	−114·0	½	−52·5	¼	−59·1	¼		
Weighted mean	−104·80		− 98·93		−103·20		− 93·64		− 58·40		− 55·00			
V_e	15·66		− 20·70		− 20·70		20·70		− 24·26		− 24·26			
V_d	+ ·13		+ ·05		− ·11		− ·18		− ·09		− ·15			
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28			
Radial Velocity	−121·		−120·		−124		−120·		− 83·		− 80·			

SUMMARY OF OTTAWA MEASURES OF BOSS 2484

Plate	Observer*	Date	Julian Date 2,420,000 +	Phase	Primary			Secondary		
					Vel.	Wt.	O-C	Vel.	Wt.	O-C
		1915								
6790	H	Feb. 17	546·664	3·63	−5·9					
6800	H–Y	" 18	547·730	4·70	19·4					
6809	C	" 19	548·710	5·68	16·8					
6816	Y	" 21	550·723	7·69	−39·3					
6823	H	Mar. 1	558·776	15·74	+78·9	1	+ 2·3	131	1	14
6830	H–C	" 3	560·721	17·69	+ 5·0					
6838	H	" 4	561·696	2·68	− 7·1	4	+ 1·0			
6846	Y	" 7	564·692	5·67	−26·3					
6852	Y	" 9	566·651	7·63	11·8					
6861	P	" 13	570·730	11·71	26·7					
6865	Y	" 14	571·656	12·64	18·0					
6870	H	" 15	572·656	13·64	·8·4	11	+ 1·7			
6876	H	" 18	575·635	0·63	+ 65·5	4	+ 0·5			
6881	Y	" 19	576·653	1·65	−10·6					
6897	Y	" 30	587·591	12·59	18·4					
6900	H	April 3	591·536	0·54	+76·8	3	+ 6·8			
6902	Y	" 4	592·583	1·59	+ 4·4					
6915	H	" 12	600·678	9·69	−29·1					
6921	Y	" 13	601·627	10·64	− 22·6					
6932	P	" 17	605·674	14·68	+26·7	1	+ 3·7			
6934	C	" 19	607·660	0·68	+ 64·3	3	+ 2·0			
6985	C	May 5	623·672	0·71	+39·0					
6986	H	" 13	631·573	8·61	38·4					
7327	Y	Oct. 9	780·927	14·09	0·0					
7333	H	" 10	781·862	15·02	+ 51·8	1	+ 11·2			
7337	C	" 11	782·927	0·10	+ 75·3	1·4	6·7			
7338	H	" 12	783·927	1·10	+ 42·8	1·6	0·2			
7367	H	" 26	797·938	15·11	+ 51·4	1	− 6·0			
7403	H	Nov 12	814·858	0·06	+ 77·4	3	− 4·6			
7404	H	" 12	814·915	0·12	+ 80·0	2·6	− 2·0			
7408	Y	" 13	815·849	1·05	+ 33·1	1	− 6·9	− 79	0·5	+ 3
7461	H	Dec 28	860·802	14·03	− 6·8					
7468	Y	" 30	862·767	0·01	+ 71·1	3	−10·9	−116	1	+ 8
7469	Y	" 30	862·840	0·09	+ 99·7	1	+ 17·7	129	1	− 5
		1916								
7486	Y–H	Jan 14	877·669	14·92	+ 31·2	2	3·8	76	0·5	− 7
7487	H	" 14	877·725	14·97	+ 43·1	1·	+ 4·1	80	0·5	− 18
7500	Y–H	Feb 1	895·650	0·92	+ 51·2	1	− 0·8			
7554	H	Mar 2	925·509	14·80	+ 10·9	1	17·1			
7535	H	" 2	927·570	14·86	+ 21·4	1	44·2	81	0·5	− 15
7537	H–Y	" 2	925·681	14·97	+ 38·8	2	0·2			
7538	H	" 3	926·570	15·86	+ 87·3	1	+ 7·3	121	1	+ 0
7544	P	" 11	934·516	8·02	27·8					
7557	Y	" 19	942·564	15·87	+ 87·9	3	+ 7·9	120	1	+ 1
7559	H	" 19	942·694	0·01	+ 85·6	3	+ 5·6	124	1	+ 0
7560	H	" 19	942·764	0·08	+ 78·2	3	− 1·8	120	1	− 4
7599	H	April 5	957·581	14·90	+ 25·4	3	− 7·6			
7600	H	" 5	957·663	14·98	+ 45·9	2	+ 6·9			
7602	H	" 5	959·625	0·96	+ 47·2	3	− 4·4	− 88	1	+ 5
7603	H	" 5	959·694	1·03	+ 48·1	3·4	+ 0·7	− 80	1	+ 4

*C – Cannon, H – Harper, P – Plaskett, Y – Young

MOUNT WILSON OBSERVATIONS

Date	Julian Date	Phase	Primary		Secondary
			Vel.	O–C	Vel.
1912, Jan. 28	2,419,410·976	2·95	−13·7	.....	.....
April 28	521·749	1·82	+ 1·	.....	.....
May 28	551·674	15·76	+76·	− 2	−151
Dec. 28	765·912	6·19	−22·8	.....	.....
1913, Mar. 25	852·748	13·10	− 9·4	.....	.....

The 30 measures of the primary, previously referred to as most trustworthy, were grouped according to phase into 8 normal places and the 13 measures of the secondary into 3 others. These were combined into one least-squares solution as indicated in the *Publications of the Dominion Observatory,* Vol. I, page 327.

NORMAL PLACES

	Velocity	Wt.	Phase from T		Residual O–C	
			Preliminary	Final	Preliminary	Final
1	+ 23·2	·6	14·83	14·84	− 6·6	− 7·9
2	+ 45·1	·7	14·99	15·00	+ 7·3	+ 5·8
3	+ 81·2	1·4	15·87	15·88	+ 1·6	+ 0·8
4	+ 80·0	1·1	·07	·08	− 1·5	− 2·0
5	+ 68·5	1·0	·61	·62	+ 2·0	+ 1·9
6	+ 45·2	·9	·98	·99	− 3·2	− 3·1
7	− 7·1	·3	2·67	2·68	+ 0·5	+ 1·0
8	− 8·4	·8	13·64	13·65	+ 1·5	+ 1·7
9	− 79·0	·1	14·90	14·91	−12·5	−10·6
10	−122·9	·4	15·93	15·94	+ 1·2	+ 0·1
11	− 80·7	·2	·98	·99	+ 4·4	+ 3·8

The following were chosen as preliminary elements.

P = 15·986 days
e = ·51
ω = 355°
K = 62 km.
K_1 = 75 km.
γ = 12·0 km.
T = J.D. 2,419,408·04

The period was considered fixed from a comparison of Mount Wilson observations with our own and observation equations were built up connecting the residuals with the remaining six elements. Making the transformations,

$$\begin{aligned} x &= \delta\gamma \\ y &= \delta K \\ z &= \delta K_1 \\ u &= 100.\delta e \\ v &= 100.\delta\omega \\ w &= [1\cdot79075]\cdot\delta T \end{aligned}$$

The observation and resulting normal equations are as follows:—

OBSERVATION EQUATIONS

	Weight	x	y	z	u	v	w	$-n$
1	·6	1·000	+ ·675	.....	− ·704	+ ·639	− ·778	+ 6·6=0
2	·7	1·000	+ ·804	.....	− ·628	+ ·619	− ·843	− 7·3
3	1·4	1·000	+1·477	.....	+ ·912	+ ·180	− ·346	− 1·6
4	1·1	1·000	+1·508	.....	+ ·994	+ ·020	+ ·017	+ 1·5
5	1·0	1·000	+1·267	.....	+ ·078	− ·376	+ ·742	− 2·0
6	·9	1·000	+ ·974	.....	− ·504	− ·521	+ ·787	+ 3·2
7	·3	1·000	+ ·071	.....	− ·128	− ·531	+ ·304	− 0·5
8	·8	1·000	+ ·034	.....	− ·222	+ ·573	− ·348	− 1·5
9	·1	1·000	.....	− ·726	+1·035	− ·765	+ ·975	+12·5
10	·4	1·000	.....	−1·494	− ·960	− ·158	+ ·284	− 1·2
11	·2	1·000	.....	− ·974	+ ·820	+ ·631	− ·952	− 4·4

NORMAL EQUATIONS

$$
\begin{array}{rrrrrrrr}
7{\cdot}500x & +6{\cdot}876y & -\ {\cdot}866z & +\ {\cdot}798u & +\ {\cdot}479v & -\ {\cdot}296w & -2{\cdot}320 & = 0 \\
+6{\cdot}876x & +8{\cdot}716y & & +2{\cdot}575u & +\ {\cdot}076v & +\ {\cdot}159w & -2{\cdot}009 & = 0 \\
-\ {\cdot}866x & & 1{\cdot}138z & +\ {\cdot}346u & +\ {\cdot}027v & -\ {\cdot}055w & +\ {\cdot}663 & = 0 \\
+\ {\cdot}798x & +2{\cdot}575y & +\ {\cdot}346z & +3{\cdot}663u & -\ {\cdot}082v & -\ {\cdot}114w & -\ {\cdot}189 & = 0 \\
+\ {\cdot}479x & +\ {\cdot}076y & +\ {\cdot}027z & -\ {\cdot}082u & +1{\cdot}395v & -1{\cdot}852w & -3{\cdot}700 & = 0 \\
-\ {\cdot}296x & +\ {\cdot}159y & -\ {\cdot}055z & -\ {\cdot}114u & -1{\cdot}852v & +2{\cdot}647w & +5{\cdot}164 & = 0
\end{array}
$$

From these the following corrections were obtained.

$$
\begin{aligned}
\delta\gamma &= -1{\cdot}11 \text{ km.} \\
\delta K &= +1{\cdot}34 \text{ km.} \\
\delta K_1 &= -1{\cdot}36 \text{ km.} \\
\delta e &= -\ {\cdot}006 \\
\delta\omega &= +0^\circ{\cdot}17 \\
\delta T &= -0{\cdot}013 \text{ day}
\end{aligned}
$$

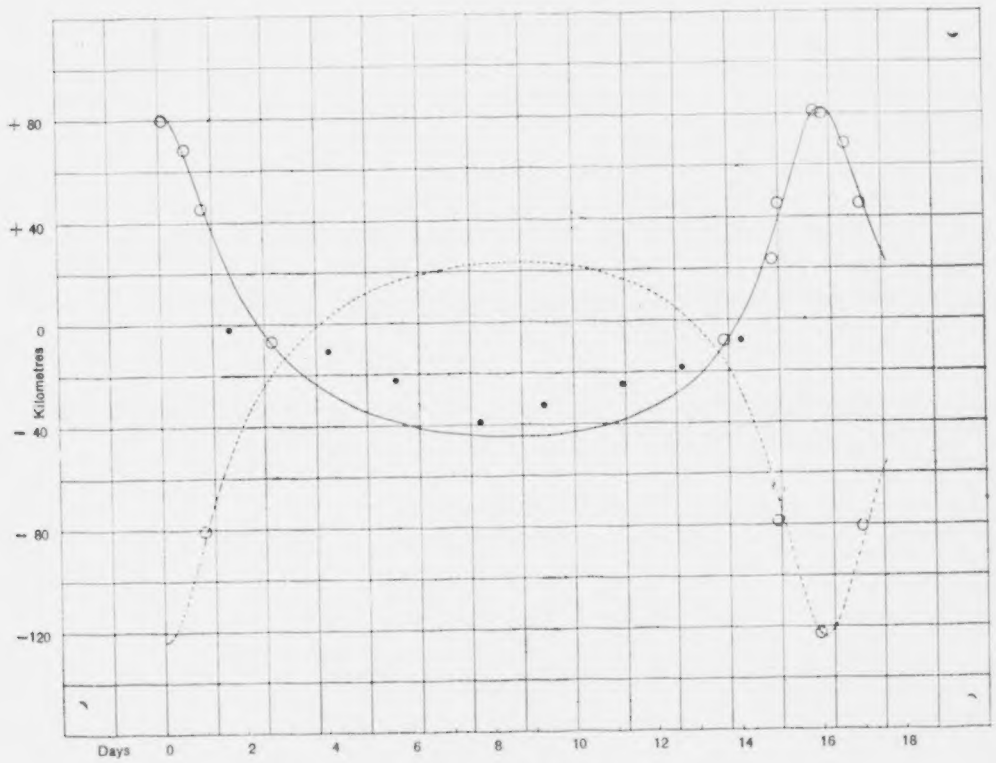
The value of Σpvv for the normal places was reduced from 105 to 95·. The probable error of a plate, based on the 30 employed in the solution, is ± 3·8 km. per second for the primary, and ± 5·3 for the secondary.

The following, then, are the revised elements, with their probable errors which are given as provisional for the time being.

$$
\begin{aligned}
P &= 15{\cdot}986 \text{ days} \\
e &= \ {\cdot}504 \pm{\cdot}025 \\
\omega &= 355^\circ{\cdot}2 \pm 7^\circ{\cdot}0 \\
\omega_1 &= 175^\circ{\cdot}2 \pm 7^\circ{\cdot}0 \\
K &= 63{\cdot}34 \text{ km.} \pm 3{\cdot}35 \text{ km.} \\
K_1 &= 73{\cdot}64 \text{ km.} \pm 3{\cdot}98 \text{ km.} \\
\gamma &= -13{\cdot}11 \text{ km.} \pm 3{\cdot}50 \text{ km.} \\
T &= \text{J.D. } 2{,}419{,}408{\cdot}027 \pm{\cdot}143 \\
a \sin i &= 12{,}026{,}000 \text{ km.} \\
a_1 \sin i &= 13{,}981{,}000 \text{ km.} \\
m \sin^3 i &= 1{\cdot}48 \odot \\
m_1 \sin^3 i &= 1{\cdot}27 \odot
\end{aligned}
$$

In the accompanying graph the continuous curve represents the primary, the dotted curve the secondary. The open circles represent the grouped observations used in the least-squares solution, while the dots represent the unused observations grouped usually two together. The latter show the effect of the blending of the spectra on the measurement, as they all fall off the main curve on the side towards the γ-line. This condition is preferred, however, to using their erroneous values in the solution.

Dominion Observatory
Ottawa
April, 1916.



Provisional Velocity Curves of Boss 2484